building the future

a guide to building without pvc

GREENPEACE

Cover photo and right: Detail from the Jewish School in Berlin. Architect: Zvi Hecker. The building is largely free of PVC in line with Berlin City Council's restrictions on the use of PVC in public buildings.

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contents

foreword

This report outlines the serious environmental problems that result from the manufacture, use and disposal of PVC. But there are practical steps that can be taken today to tackle this threat. Architects, local authorities, civil engineers and developers can choose not to specify PVC but to specify more environmentally acceptable alternatives. Many companies, national and local governments, and communities are already making that choice. This report outlines some of these progressive steps and describes the alternative building materials that are available now to replace PVC in all new and refurbished building and construction projects.

We are not suggesting that the alternatives presented here do not have an impact on the environment. However, the crucial point is that eliminating PVC, through a switch to alternatives, represents tangible progress towards protection of the global environment and human health. This move can have wider benefits; just as eliminating CFCs – ozone depleting chemicals – led to greater innovation in the search for and implementation of environmentally acceptable alternatives.

The supplement to **building the future** gives a list of suppliers of these alternatives, which has been compiled by the Association of Environmentally Conscious Builders. It aims to be as comprehensive as possible, but there are undoubtedly some products and company contacts missing. Greenpeace supports a switch to these alternatives, but does not endorse any single product or company.

This is a practical guide; please let Greenpeace know of your progress in taking steps to deal with the environmental threat of PVC by choosing better alternatives.

Greenpeace October 1996

summary

The centrepiece of the year 2000 Olympics, the Sydney Olympic Stadium, is being designed to minimise the use of PVC plastic. Germany's capital city, Bonn has recently agreed far-reaching restrictions on the use of PVC in public buildings. Many local councils all over Europe have already restricted the use of PVC in building projects. In Sweden, the Government has agreed to phase out the use of PVC. Why is PVC being replaced in buildings from Sydney to Gothenburg ?

This report seeks to answer this question by explaining the environmental concerns over PVC plastic. It also shows how this material can be easily replaced in new building design or refurbishment of offices, restaurants, hospitals and housing.

Although you may already be aware of the problems associated with PVC in accidental fires in buildings, the production, use and disposal of PVC also results in the creation and release of large amounts of toxic chemicals. These substances end up in the environment, adding to the level of persistent toxic chemicals which are building up in the air, soil and water, in the food chain and in our bodies.

At the same time, there is increasing scientific evidence to suggest that the exposure of wildlife to chemicals in the environment has resulted in widespread problems, including immune system damage and cancer. New evidence suggests that some of these chemicals can disrupt the hormonal system of animals in the wild, causing infertility,

A model of the 110,000 seater Sydney Olympic stadium for the year 2000 Olympics. The Australian Stadium Consortium which is designing and building the project is committed to using alternatives to PVC in plumbing, drainage and flooring materials.

reproductive difficulties and developmental problems for their offspring.

There is increasing concern that the trends which are being observed in humans world-wide – which include decreased sperm counts, increased incidence of testicular cancers, deformities of the reproductive organs and rapidly increasing rates of breast cancer – may also be linked to our exposure to man-made hormone-disrupting chemicals in the environment.

Not only are many of the chemicals used to make PVC toxic and carcinogenic but PVC is also an important source of two chemicals known to be hormone disruptors: dioxin and phthalates. Dioxin is one of the most toxic chemicals known to man and is inextricably linked to the PVC production process.

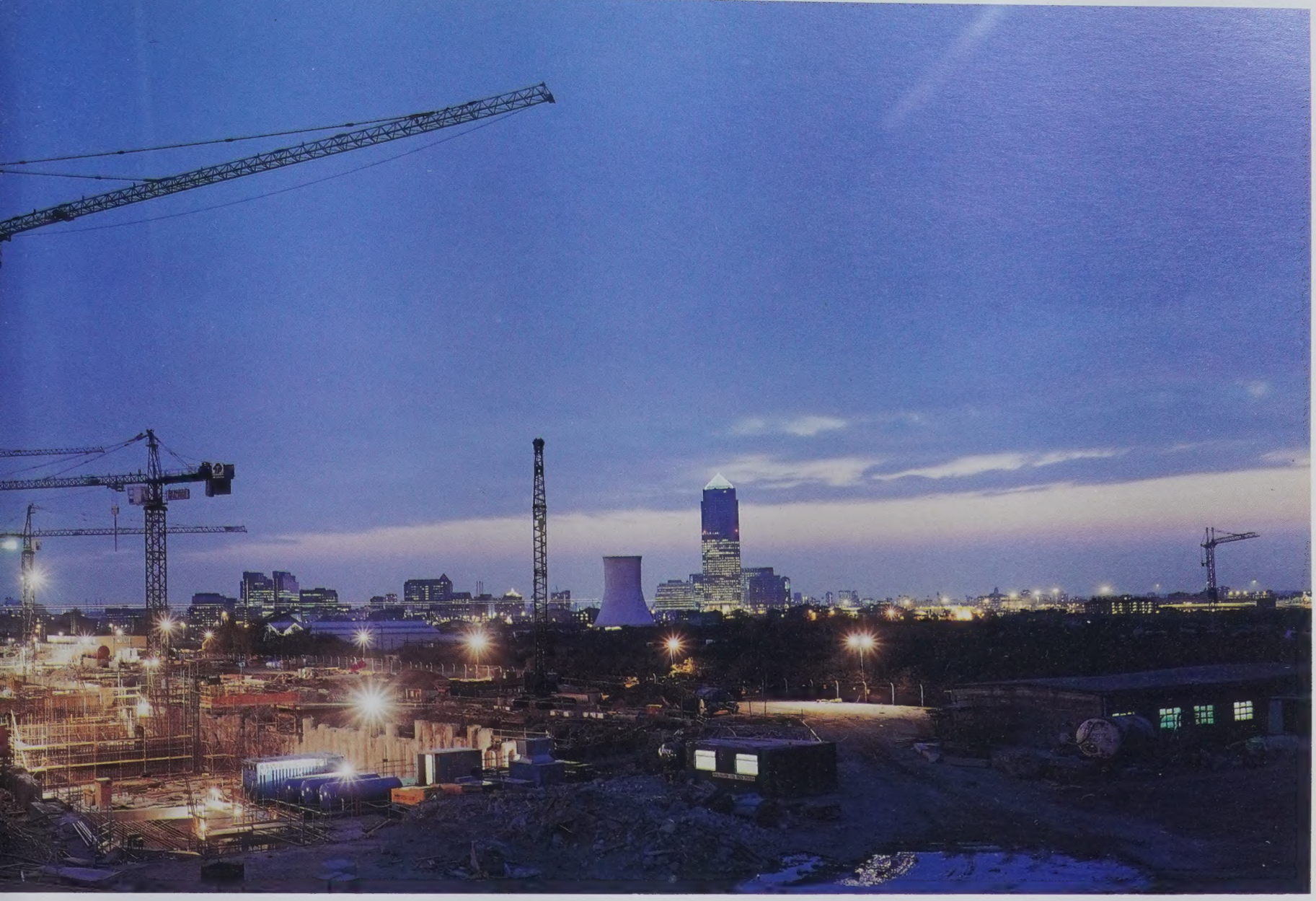
Greenpeace believes that the best way to begin to reduce the widespread contamination of the environment and our bodies is to replace PVC with other materials, and end its production.

It is possible to specify alternatives to all the major uses of PVC in buildings, whether it be in flooring, underground drainage or cabling.

Greenpeace calls on all those involved in making decisions about building materials to specify alternatives to PVC in homes, offices and public buildings. A change from PVC building materials to alternative products means real progress towards protection of the global environment and human health.

Construction of the North Greenwich station on the Jubilee Line Extension. The cabling on the underground section will use PVC-free cable in line with London Underground's policy.
(Photo: Jubilee Line Extension Project)

The Berlin Museum of Jewish Culture under construction. The Museum will be totally PVC-free.
Architect: Daniel Libeskind.



"The question is not whether to phase-out PVC but how PVC should be phased out"

Anna Lindh, Swedish Minister for Environment, November 1995

Right: Entrance to part of Bilbao's new metro system designed by Sir Norman Foster which uses PVC-free cabling for environmental and safety reasons.

Below: Interior of PVC-free Oberpallen School in Luxembourg. Architect: Laurent Biever.

The decision to move away from PVC has already been taken by many local authorities, institutions and architects outside the UK. Most significantly, the Swedish Parliament made a commitment in November 1995 to a total phase-out of soft PVC and rigid PVC with harmful additives.

One hundred and twenty eight communities in Sweden, including Gothenburg, have already implemented restrictions on the use of PVC in public buildings.

In May 1996, two of Sweden's leading construction companies, JM and Svenska Bostder, announced that they are phasing out their use of PVC. Other major Swedish construction companies, NCC, SIAB and Skanka plan to follow. SIAB's environmental director Eva Mensson said "I don't think anyone in the construction business today believes there is a future for PVC".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This page: The Jewish School in Berlin, Architect: Zvi Hecker. The building is largely free of PVC in line with Berlin City Council's restrictions on the use of PVC in public buildings.

Opposite page: The Berlin Museum of Jewish Culture under construction. Architect: Daniel Libeskind. The museum will be completely PVC-free; some of the PVC-free cabling used throughout the building can be seen.

In Australia, the Olympic Building Programme for the year 2000 Olympics has chosen to avoid all chlorine compounds including PVC wherever possible. The Australian Stadium 2000 Consortium which won the competition to design, construct and build Sydney's Olympic 110,000 seater stadium included a number of environmental features in its proposal, including a commitment to minimise the use of PVC. In particular the Consortium is committed to using alternatives to PVC in plumbing, drainage and flooring materials for the project.

The Austrian city of Linz has recently achieved an 85% PVC phase-out in public buildings. Six of the nine regional governments in Austria have now placed restrictions on the use of PVC.

In February 1996, Germany's capital city, Bonn, agreed that PVC should be largely avoided in public buildings: schools, kindergardens, old people's homes and subway stations. In Berlin, over 130 public buildings have been built since 1989, with restrictions on the use of PVC.

Elsewhere in Germany, around 200 local authorities and six Federal States have agreed to restrictions on PVC use.

Right: The restoration of the late 18th century Krohnengen School in Bergen, Norway, avoided the use of PVC in accordance with Bergen's restrictions on PVC use.

Far right: Classroom in Oberpallen school in Luxembourg. The renovated school buildings are completely free of PVC and are highly energy-efficient. Architects: Laurent Biever (interior) and Atelier d'Architecture BENG (exterior).

Right: Deutche Opera building in Berlin – restored largely without PVC.

Far right: Part of the new Museum of Transport and Technology, Berlin, which is being built largely without PVC.

The Danish Government is currently considering restrictions on PVC by the year 2000.

Norway's second largest city, Bergen, made a decision in 1991 to phase out PVC in public buildings. Many new buildings and restoration projects have been completed since then with minimal use of PVC.

London Underground has now banned halogenated cables, which includes those made of PVC, from its underground stations as a result of concerns over fire hazards following the Kings Cross fire. In addition the underground systems in Vienna, Berlin and Dusseldorf no longer use PVC cables.

New building projects in Germany where large amounts of cabling are used, are often executed with PVC-free wiring, for example North German Television's studio in Hamburg.

In 1991, the Swedish furniture distributor IKEA announced it intended to phase out PVC in all products.[1]

Family Law Building, Berlin, built in 1995 largely without PVC.

Left: The Berlin Town Hall in Alexanderplatz, restored 1990 1997 largely without PVC

Left: Social Housing project for young people in Schoneberg, Berlin. The restored building is completely PVC-free. Architect: Alexander Rudolphi

Right: The Berlin Philharmonie restored largely without PVC.

pollution from pvc production and disposal

Although it is not immediately obvious, a PVC pipe, floor tile or cable is the product of a highly polluting section of the chemical industry.

From the processing of its raw materials through to its disposal, PVC creates environmental and human health problems.

The origins of these problems lie in the properties of the toxic chemicals that are used to make PVC plastic. The main group of chemicals are called organochlorines as they are derived from chlorine. They tend to be soluble in fat – not water – which means that once in the environment, they build up in the food chain.[2] They are often highly persistent.[3]

Several types of chlorinated chemicals, other than the ones used to make PVC, have been banned, phased out or restricted, following the revelation of their environmental and human health effects. These include chemicals such as PCBs, CFCs and the pesticide DDT.

Making PVC from chlorine

- PVC is usually made by chlorinating ethylene (a product of the petrochemical industry) to make ethylene dichloride (EDC).
- Not only is the chlorine gas itself highly toxic, but one of the manufacturers of this gas in the UK still uses a mercury-based technology which releases mercury to the environment.
- This method of creating chlorine also creates dioxin residues, as does the production of EDC.
- This process is also highly energy-intensive.
- During the manufacture of EDC, large amounts of EDC are released to the atmosphere.
- The production process creates thousands of tonnes of highly toxic, tarry wastes, which are also contaminated with significant amounts of dioxin[4]. Many other toxic organochlorines such as hexachlorobenzene are also created as by-products.[5]
- Next, EDC is converted to vinyl chloride monomer (VCM). Some VCM gas is released into the air around VCM factories.
- The VCM is then converted to poly vinyl chloride - PVC. Sometimes this process is carried out within the same factory, but frequently highly toxic and explosive VCM gas is transported all over the world to make PVC.

Toxic chemicals including dioxin and mercury, arising from PVC production processes have contaminated the environment around ICI's Runcorn factory.

In order to transport VCM, this chemical gas has to be compressed and liquefied. Any leaks can lead to explosions. Large VCM fires are almost impossible to contain and pose enormous hazards to fire crews.[6]

Underground dumping

In the UK the highly contaminated wastes which result from making PVC are dumped in underground caverns in Cheshire. Nine thousand tonnes a year have been dumped for at least 30 years. It is estimated that the caverns now contain over 330,000 tonnes of toxic waste, including large amounts of dioxin.[7] There are no guarantees that over time this underground dump will not leak. In a recent television documentary a geologist commented that toxic waste from the dump could be squeezed out into the surrounding land and water along the fractured surfaces between the salt layers.[8] These wastes are so highly contaminated that any attempt to dispose of them, for example by incineration, will lead to the creation of other toxic by-products.

Environmental problems of additives to PVC

The manufacture of raw PVC is itself a highly polluting process, but more environmental problems are created by the extra toxic chemicals that are added to PVC to give it different qualities such as plasticity, fire-resistance etc. In many cases the final PVC product will contain relatively little raw PVC – additive chemicals acting as stabilizers, plasticisers, pigments, optical brighteners, flame retardants, biocides, fillers, foaming agents and lubricants can make up over 50% of the final product.[9]

One of the chemicals added to PVC to make it soft and plastic is the phthalate DEHP.

DEHP can enter the environment during the production and manufacturing process, it can leach from PVC products during use, and following disposal, DEHP may leach from discarded PVC products in landfills.[10] DEHP is now widely distributed in the environment and can be found even in supposedly pristine areas such as Antarctica.[11]

Pollution problems from disposing of PVC products

PVC does not only create pollution during its production. It also creates problems during its disposal. A large amount of PVC packaging and discarded PVC products, such as old PVC cables or flooring, end up in municipal and hospital waste incinerators.

PVC is usually the main source of chlorine in the municipal waste stream and therefore is the main contributor to dioxin formation in incinerators.[12]

Several reports have found a direct relationship between the amount of PVC in waste fed into an incinerator and the amount of dioxin emitted.[13] Dioxin from incinerators is widely distributed in the environment via contaminated ash, stack gases and waste water.

PVC in landfills

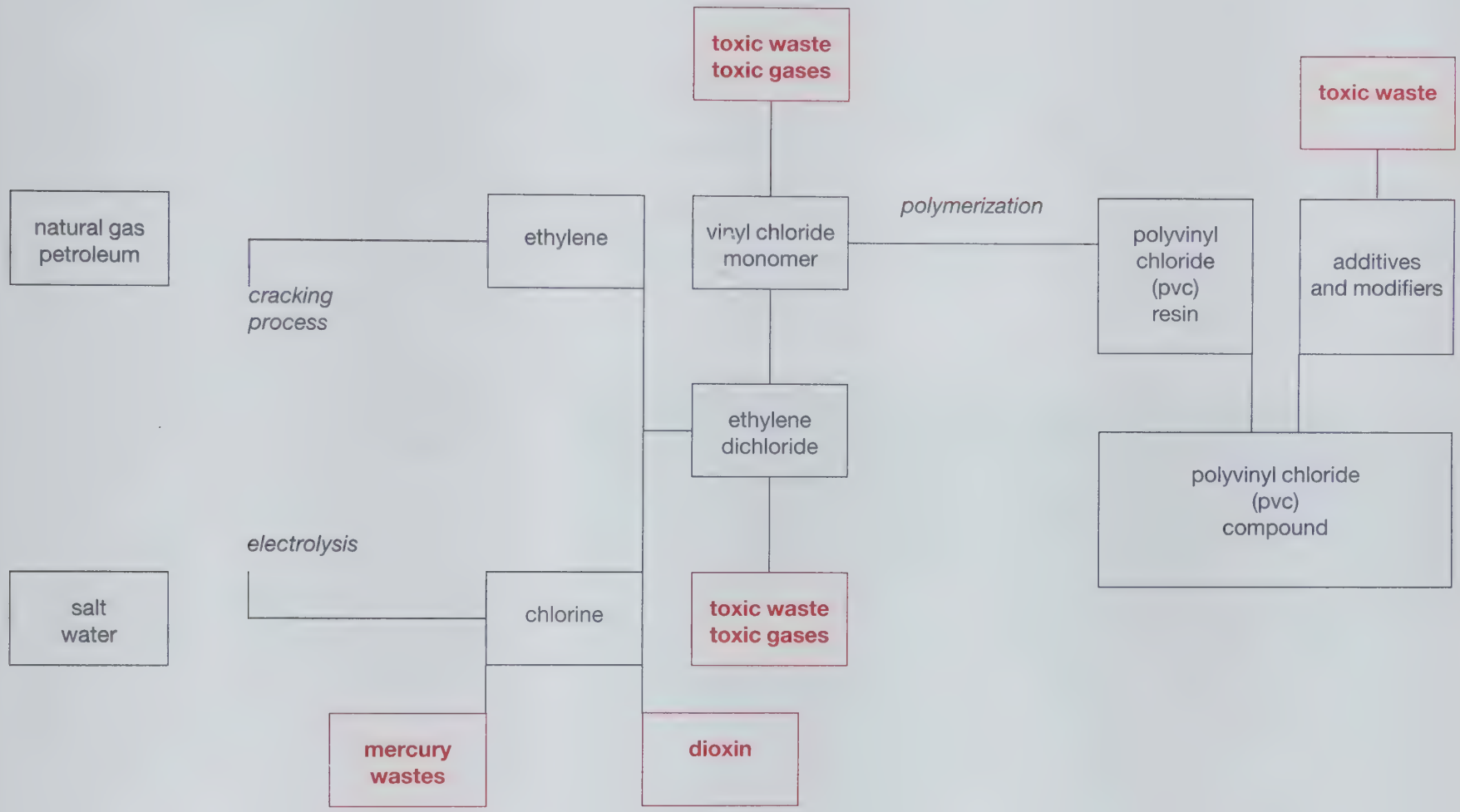
When PVC is landfilled, the various additives, such as DEHP, are susceptible to leaching.[14] These chemicals can migrate through soil to contaminate groundwater.[15]

PVC recycling

Recycling of PVC plastic is not the answer to the environmental problems that PVC creates during its production and life-cycle.

The potential for real recycling of PVC is extremely limited. The wide range of chemical additives added to PVC make it hard to create a

The PVC Production Process



consistent end product from the PVC plastics that have been collected. The sorting of PVC plastic for recycling is also complicated and expensive, especially when compared with the ease with which a material such as glass can be sorted. Virgin PVC also has to be added to most recycled PVC products.

In the recycling of post-consumer plastics, PVC can obstruct or damage the recycling of other plastics. Traces of PVC adhering to steel and copper can also create pollution problems during the recycling of these metals.[16]

Dioxin and human health concerns

There are major concerns about the human health impacts of dioxin which have been extensively studied by the US Environmental Protection Agency and other scientists. The latest findings on dioxin conclude that not only is dioxin a probable human carcinogen, but that it is also a powerful hormone disruptor. Studies in animals have shown that exposure to low doses of dioxin in the womb reduced the testosterone levels and sperm counts of male offspring.[17]

"The general levels (of dioxin) in the human population are right at the point where effects are seen in animal studies. This means that there is no margin of safety"[18]

Professor Claude Hughes, Duke University, North Carolina, member of US EPA document review group

The production of PVC is inextricably linked to the creation of dioxin as a by-product. This is acknowledged by the industry itself.[19] ICI's own figures also show that large amounts of dioxin are being created at its plant in Merseyside.[20] Investigations outside the UK have shown that sediments from the River Rhine have increased concentrations of dioxin near a VCM plant in the Netherlands.[21]

The problem of dioxin production as a by-product of PVC manufacture and incineration is not just one of local contamination. Dioxins do not break down for decades, and because they are highly persistent they can spread far and wide in the environment and build up in the food chain, concentrating in those mammals – including humans – at the top. [22]

Dioxin gets into the food chain either through the air, ending up on grass eaten by cows for example or into the marine food chain from

Oberpallen School in Luxembourg. PVC free. Architect: Laurent Biever.

discharges to rivers which end up in fish and marine mammals. Dioxins from ICI's Runcorn plant end up in the Mersey and the wider marine environment.[23]

The levels of dioxin in the UK environment – in our soil, water and food – already give cause for concern. If dioxin levels in the UK environment are to be reduced, then PVC production and incineration must be phased out. At the moment the best way to achieve this, in the absence of government action, is by starting to specify alternatives to PVC wherever possible.

Phthalates and PVC

Some phthalate chemicals which are used as plasticisers in soft PVC have already been identified as possible human carcinogens.[24] Some have recently been identified as hormone disruptors which act by mimicking the female hormone oestrogen. Chemicals that act as oestrogen mimics can disrupt the development of the reproduction system in a foetus, if consumed by the mother at the critical period of pregnancy. DEHP, the plasticiser most used in PVC, belongs to this group of chemicals.[25] DEHP is of concern because it is so widely distributed in the environment, making it possible for people to be exposed to high doses. Other plasticisers, also used in PVC, are also known to be oestrogen mimics.

Heavy metal pollution

Over the last hundred years, the PVC production process in the UK has been carried out largely in Merseyside, and has contributed to high mercury discharges to the River Mersey. For example, severe mercury contamination has affected Liverpool Bay.[26] Fish have become contaminated[27] and a number of commercially important species often exceed European guidelines.[28] The Ministry of Agriculture advises anglers not to consume fish caught in the Mersey because of the levels of lead and mercury contamination.[29]

Toxic heavy metals such as lead and cadmium have been widely used as additives to PVC; in particular products such as PVC cladding and windows have traditionally contained heavy metals such as cadmium. These heavy metals may be released into the environment if the product is incinerated, burnt in an accidental fire or buried in a landfill.

Vinyl chloride (VCM): health effects

Research on VCM, one of the building blocks of PVC, has linked it to: various cancers; angiosarcoma; increased incidence of liver, lung and brain tumours; and both male and female reproductive disturbance.[30] Significant increases in congenital abnormalities have been reported in communities close to VCM plants.[31]

pvc and fire safety

You may already be aware of some of the problems caused by PVC in fires.

The UK's Fire Brigade Union is concerned about the safety of PVC building materials such as cables and flooring in the event of a fire, both in terms of the toxicity of the smoke produced and the destructive effects of hydrochloric acid on a building structure.

A fire officer with a protective face mask stands in the burnt out Dusseldorf airport terminal hall. [illegible] 12 April 1996

A fire at Dusseldorf Airport in April 1996 caused the death of 16 people. The fire started when PVC cables were ignited by sparks from a welder's torch. Toxic gases such as hydrogen chloride were created. Large parts of the airport were later found to be contaminated with high levels of dioxins and furans. The local environment authority said that PVC had substantially contributed to the formation of these chemicals. [32]

The German Federal Office of the Environment has drawn attention to the dangers arising from PVC in fires, in relation to the formation of hydrogen chloride gas – which creates corrosive hydrochloric acid on contact with moisture.

"The high chlorine content of PVC products may give rise to major hydrogen chloride emissions. Hydrogen chloride...may cause burns in affected persons and considerable material damage through corrosion of buildings and installations... Damage caused by hydrochloric acid may necessitate extensive repair work which would not be required after fires without PVC involvement."[33]

The hydrogen chloride given off during a fire also reacts with the many additives present in PVC, creating even greater volumes of toxic fumes.[34] In addition, heavy metals contained in PVC stabilisers will be released and this is especially dangerous in the case of cadmium.[35]

One of the best documented cases of the safety threat posed by hydrogen chloride released by PVC, is the Beverley Hills Supper Club fire of 1977. During the fire, PVC wiring decomposed forming a 'wispy grey-white smoke' with no visible flames. By the time the flames became visible and the alarm was raised, it was too late. A total of 161 people died without any direct involvement with the flames, before any wood started burning and before carbon monoxide reached dangerous levels. These deaths and the many respiratory injuries were a direct result of the presence of PVC.[36]

Accidental fires in homes and buildings involving large amounts of PVC also appear to be an important source of dioxin. PVC is now ubiquitous in modern buildings, and high concentrations of dioxin have been found in residues around fires which have involved PVC.[37] Laboratory combustion tests have shown that the dioxin content of fire residues involving various PVC materials is considerably higher than that of PVC-free materials such as wood.[38] Electrical cables are usually made from PVC, and in an electrical fire, the PVC plastic sheathing is often the first material to burn.

Outside of the UK, principally in Germany and Austria, there are strict standards about the level of dioxin to which the general population may be exposed; as a result the authorities are required to clean up dioxin contamination following fires.

The high cost of dioxin clean-up following PVC fires has been a major incentive for local authorities to switch to non-PVC materials in Germany and Austria. A PVC cable fire in the telephone exchange in Dusseldorf in 1988, which was easily extinguished by the fire brigade with just ten litres of water, resulted in heavy dioxin contamination of the whole building. It took three years of cleaning up to remove the damage, at a cost of nearly 12 million dollars.

alternatives to pvc use in buildings

This section lists materials that can be specified as alternatives to PVC. These alternative materials are available to replace PVC in all its major uses in building; including flooring, electrical and information cables, guttering, underground drainage and cladding.

Pipes and ducts

In the UK one of the largest uses of PVC is in rigid pipes for above ground and underground drainage. PVC ducts are also often used to carry or protect electrical cables and gas pipes.

For underground sewage or water pipes, vitrified clay pipes are suitable and are very durable. The expected service life of a clay pipe is commonly given as 100 years; several manufacturers actually offer 100 year warranties. Clay pipes have a high resistance to chemicals in waste water. The UK clay drainage pipe company, Naylor Brothers, is promoting its products based on their environmental acceptability compared with PVC. In recent years, clay drainage pipes have been improved to the point where under normal conditions a bedding fill of granular material is not required. This saves on space, time and cost of aggregates

Alternative materials to PVC in sewage pipes may perform better over time: the city of Nyborg in Denmark reported that the PVC main sewage pipe had become extremely brittle and required frequent replacement. In the UK, Anglian Water specifies polyethylene or ductile iron pipes in its mains renovation programme. Neither does it allow developers to use PVC pipe in new sewage schemes for engineering reasons.[39]

High density polyethylene (HDPE) can also be used for sewage pipes. As PVC pipes tend to come in shorter lengths, they require more joints and have more leakage potential. HDPE pipes are more flexible and shock resistant.

For above ground drainage, ie soil and vent pipes and guttering, materials such as zinc, cast iron, copper, galvanized steel or aluminium can be used as an alternative. Metal guttering has a longer service life, although it may require some maintenance.

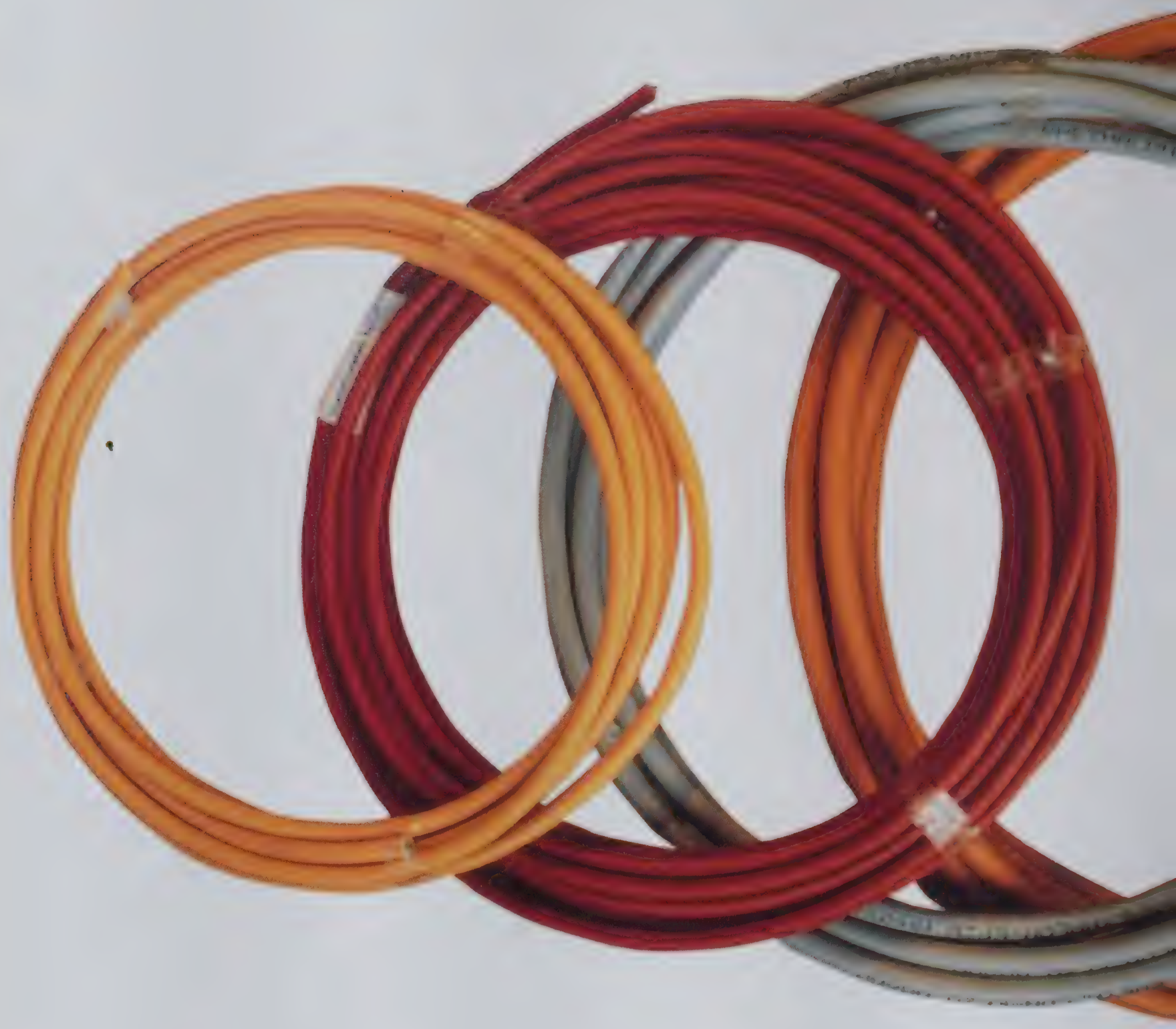
A new urban development in Leidsche Rijn, near Utrecht in the Netherlands, which will provide over 30,000 new-built houses and 700,000 m^2 of office space, is minimising the use of PVC. In particular the water and sewerage system will be PVC-free. Some of the first stages of the housing project have already been built.

PVC soil and vent pipes can be substituted with cast iron with stainless steel couplings and EPDM sealing gaskets.

It is possible to substitute PVC ducting carrying electricity cables with polyethylene (PE) and steel.

The UK gas industry now only uses medium density polyethylene (MDPE) pipe because it is more flexible than PVC pipe. MDPE is also gaining market share in the water industry.[40]

Vitrified clay pipes are preferable to PVC for underground sewage pipes and water pipes. Anglian Water does not allow developers to use PVC pipe in new sewage schemes.



Electrical Cables and Wiring

Cabling is used either to conduct information, eg data transmission cables for computers, or to conduct electrical energy: power cables. Cables manufacturers have already developed and marketed several halogen-free alternatives to PVC cable, as a result of concern over emissions from PVC cable in the event of fire. When cable is designated halogen-free this means it cannot contain PVC or any other organochlorine based chemicals.

A recent example of the move towards halogen-free cabling is the new metro system in Bilbao, Spain. Designed by Sir Norman Foster, this used PVC-free cabling made by Pirelli, for safety and environmental reasons. The new Berlin Museum of Jewish Culture, designed by Daniel Libeskind, a PVC-free building, is being wired throughout with PVC-free cable.

The main alternative power cables in the high and medium voltage range use polyethylene as an insulation and sheathing material. These types of cables are manufactured in the UK by companies such as Delta Energy Cables Ltd and are available through electrical wholesalers. Rubber sheathed cables are also available.

For low voltage uses such as domestic wiring, the alternatives are polyethylene or rubber insulated halogen-free cables. These are now available in the UK.

PVC-free cables are available in the UK for low, medium and high voltage applications. PVC-free data transmission cables are also available.

In Germany, Siemens has developed a new PVC-free power cable range (Simaclean) for residential, public and industrial buildings, which is being marketed as an environmentally-friendlier alternative to PVC.

For data transmission cables there are polypropylene and polyethylene alternatives to PVC. A good selection is manufactured by the Swiss company Datwyler, which distributes in the UK.

The other advantage of cables made from alternative plastics such as polyethylene, is that these plastics do not require the use of plasticisers such as DEHP. It is also possible to use less environmentally damaging flame-retardant fillers such as aluminium hydroxide and magnesium hydroxide.

All the alternative cable types listed above have better properties than PVC in the event of a fire, they generate less smoke, do not release hydrochloric acid or dioxins, and have fire-resistant qualities which match or outstrip PVC.

Although many cable manufacturers sell a range of halogen-free cables, they still have a small market share so you may have to ask cable dealers or wholesalers to get them in stock. The price of halogen-free cable is still higher than PVC cable but as more and more people choose PVC-free alternatives, the price difference is shrinking.

Flooring: alternatives to PVC flooring are easy to find, are competitively priced and perform as well as, if not better than, PVC.

Linoleum

Linoleum once dominated the market for elastic floorings. Then in the 1950s PVC began to take over. In recent years linoleum has enjoyed a revival, due to the new range of colours and patterns in which it is available.

Linoleum is made of renewable materials and consists mainly of vegetable linseed oil to which a natural resin is added. The mixture is spread on hessian fabric and the surface treated with water-based acrylic 'dispersion' paint. Linoleum has very low flammability, is anti-static, light resistant, sound-absorbent, resistant to fats and oils and has a natural anti-bacterial effect.

Rubber floor covering

Several companies in Europe produce rubber floor coverings. Particularly in situations such as airports or sports stadiums where floor coverings have to meet great demands in durability, rubber floor coverings have proven effective.

Rubber flooring which contains chlorine-based ingredients should be avoided. Ethylene propylene diene (EPDM) type rubber is recommended by the Danish Environmental Protection Authority as an alternative to PVC.

Wooden floors

Wood is a natural alternative to PVC flooring which is very durable and can be renovated by planing or sanding. Increasingly reclaimed wood floors are available. If using new wood, it is important to source from certified forests where clear-cutting and other environmentally damaging practices are banned.

Cork flooring

Cork is hard-wearing, very sound absorbent and popular because it is agreeable to walk on due to reflection of warmth and its natural resilience.

For the production of cork flooring the bark of the Mediterranean cork oak is stripped and ground. Cork floor coverings are available with untreated or sealed surfaces. Types which are sealed with artificial resins (polyurethane) or PVC should be avoided.

When deciding which type of flooring to specify, it is important to consider the durability of the material and the possibility of future renovation.

Only cork and wooden flooring can be renovated by planing or sanding. For that reason, these floorings have a longer durability which often justifies the higher costs of fitting.

Linoleum, rubber, cork, wood and stone are all durable alternatives to PVC vinyl flooring.

Windows

The main alternative to PVC windows are wooden window frames. Wooden window frames are easy to handle, absorb sound well and keep warmth in the house. They do not use vast amounts of energy to make, unlike PVC.

It is important to choose wood from certified forests, where clear-cutting and other environmentally damaging techniques are not practised. Reclaimed wood or local timbers like spruce, pine and larch from certified forests can be used.

An advantage of wooden window frames is their durability, providing maintenance is kept up. Wooden windows can last for over 50 years and even after that time can be renovated, whereas PVC windows have to be totally replaced after a much shorter period.

There are many companies which will restore old wooden windows as well as companies offering new wooden windows. Wooden windows can be combined with energy efficient double or triple glazing for energy saving.

Though maintenance of high performance wooden windows is minimal, some may consider them unsuitable for a small percentage of buildings. In this case aluminium and wood combination windows, should be considered in preference to PVC.

Profiles

PVC is used for a huge variety of purposes such as facia boards, window sills etc. Alternative materials are wood, steel, other plastics such as polyethylene (PE) and polypropylene (PP), depending on the specific purpose. The alternative materials are both technically and financially competitive with PVC.

Cladding

PVC cladding is often used by the building industry as a cheap substitute for wood on the exterior of buildings to protect the fabric beneath or for decorative effects. However its appearance will change over time. PVC cladding is susceptible to yellowing, bleaching, and 'chalking' as a result of complex chemical changes brought on by exposure to heat, UV light and moisture. The yellowing of PVC cladding can be more prevalent in wetter, Northern areas.[41] PVC cladding will also become more brittle over time.

Alternatives to PVC cladding include wood (local produced pine or spruce) or various composite siding products with recycled fibre content. These may require increased maintenance. Steel, concrete and stone panels can also be used.

Building Membranes

PVC is often used in different water-proofing applications, in particular tensile structures, roof membranes, and geomembranes. There are non-PVC alternatives available for all these uses.

Tensile or stressed fabric structures have become commonly used in place of conventional roofs in recent years, particularly for buildings used for social gatherings or of a semi-permanent nature. Large amounts of PVC treated material will pose risks in the case of a fire. Alternatives include canvas and silicon-coated fabrics.

The alternatives to PVC roof membranes are made of ethylene propylene diene monomer rubber (EPDM). By avoiding PVC in this application, workers also avoid exposure to fumes released during welding of PVC roof membranes.

There are a wide range of products available to replace PVC geomembranes used in landscaping and civil engineering, for example in lining lakes and reservoirs; these are mostly made of rubber.

Timber window frames with energy efficient glazing at Greenpeace UK office, London.

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